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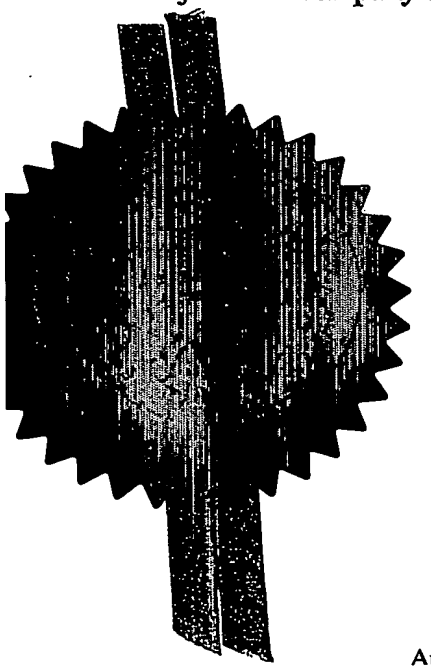

Signed Andrew Gerrey

Dated 7 May 2004

PRIORITY DOCUMENT

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Patents Form 1/77

Patents 1977
(Rule 16)

THE PATENT OFFICE
27 MAR 2003
LONDON

28MAR03 E795901-6 D02000
P01/7700 0.00-0307111.5

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — MCM/ASB/25408

2. Patent application number *(The Patent Office will fill in this part)* — 0307111.5 — 27 MAR 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Helmet Integrated Systems Limited
Unit 3, Focus 4
Fourth Avenue
Letchworth
Hertfordshire SG6 2TU
United Kingdom

Patents ADP number *(if you know it)* 8569824001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

Respirator

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

MATHYS & SQUIRE
100 Gray's Inn Road
London WC1X 8AL
United Kingdom

Patents ADP number *(if you know it)* 1081001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	5
Claim(s)	2
Abstract	1
Drawing(s)	5 + S

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature MATHYS & SQUIRE Date 27 March 2003

12. Name and daytime telephone number of person to contact in the United Kingdom: Michael C Moir - 020 7830 0000

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Notes

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b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

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RESPIRATOR

The present invention relates to a respirator, for example, for a visored helmet.

A respirator of self-contained form for use in oxygen-sufficient atmospheres is described in GB 2,183,488. The respirator includes a domed shell incorporating a harness for engagement with a user's head and having a visor depending from the front of its rim to extend over and round the user's face. The shell is spaced above the harness, and projects forwardly and rearwardly of the harness, to define a passageway which extends from a rear opening across the head and then downwardly over the face behind the visor. A battery-driven electric fan is located in the passageway adjacent its rear opening to draw ambient air into the opening to flow through the passageway. The shell is provided with a pad filter fitted across the passageway rear opening.

As the filter becomes blocked or as the voltage of the fan battery falls, the air flow through and the pressure within the respirator will fall, reducing the efficiency of the respirator and thus the protection afforded to the user. In order to detect the falling efficiency, it is know to mount devices within the respirator which provide a visual indication to the user that the degree of protection is falling. For example, GB 2,130,893 describes the mounting of a float-type pressure gauge within the respirator and the field of view of the user. However, such devices are unable to provide any active control of the air supply within the respirator.

In at least its preferred embodiment, the present invention seeks to solve these and other problems.

The present invention provides a respirator comprising a hood for enclosing at least the face area of a user, a filter, a fan for generating a flow of air through the filter, a duct for delivering the flow of filtered air to the vicinity of the user's face, a bypass conduit for abstracting a portion of the flow from the duct and subsequently returning the abstracted portion to the remainder of the flow, means for measuring the flow

rate of air through the bypass conduit and means for controlling the fan in response to the measured flow rate.

Other advantageous features are illustrated in the dependent claims, the description given below and the appended drawings.

Preferred features of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a side perspective view of a respirator;

Figure 2 is a perspective view of the respirator of Figure 1;

Figure 3 is a side perspective view of the respirator of Figure 1 with some components partially omitted to show the location of the air duct;

Figure 4 illustrates a cross-sectional view of the respirator of Figure 1;

Figure 5 illustrates a cross-sectional view of the filter and fan of the respirator; and

Figure 6 illustrates a system for controlling a fan of the respirator of Figure 1.

With reference to figures 1 to 4, respirator 10 comprises a hood having a domed, impact resistant outer shell 12 attached to a rigid, inner shell 14 carrying a visor 16 pivotally attached thereto. The peripheral edge of the inner shell 14 is sealed to a head cowl 18 made to fit a range of head sizes of designated users. The cowl envelops the head of the user and, together with the inner shell 14 and visor 16, defines a breathing zone for the user 20. A neck seal 22 (figure 4) is attached to the cowl so as to seal in use around an upper part of a user's neck. Alternatively, the head cowl 18 may be incorporated in a full body suit.

Air is delivered to the breathing zone by an air delivery duct 24 extending from the

rear of the inner shell 14 to deliver a flow of air in the vicinity of the face of the user 22. A fan 26 located at the rear of the inner shell 14 propels air through the duct 24. An air filter 28 is provided to filter air entering the fan 26 via air inlets 27. The fan 26 is powered by batteries 29 which may be either removably housed in compartments 29a located proximate the ears of the user on either side of the shell 14 (to provide for a low centre of gravity for the respirator), or otherwise provided in a belt pack strapped to the waist of the user 22. Exhalate from the breathing zone issues from the respirator 10 via one or more apertures 44 which may be valved in the lower portion of the respirator.

With reference to figures 4 and 5, air entering the air filter 28 through the air inlets 27 passes through pleated glass fibre papers 30 which filter the air flow, and leaves the filter 28 through a central aperture 31. The filter 28 carries a screw thread 32 to enable the filter 28 to be releasably secured to a conformingly profiled thread formed on the inlet structure 33 of the fan casing for ease of replacement of the filter. The fan 26 is a tangential fan in which the air is turned from parallel to the axis of rotation on entry to a direction tangential to the arc described by the tips of the rotating blades of the fan so as to be discharged through an elbow into the duct 24.

The chassis 34 has a U-section annulus that holds a resilient anti-vibration mounting which, in turn, holds the two major parts 37, 38 of the fan casing. The fan motor 40 is directly mounted on to the fan 26, and is switched on and off by a microswitch operated by a quadrant arm 42 that rests against the user's head.

This arrangement of the air filter and fan serves to position the air filter closer to the back of the user's head, bringing the centre of gravity of the respirator close to the centre of the user's head. In addition, no recirculation plate is required; the inlet structure 33 preventing substantial recirculation.

In order to control the air flow through the breathing zone, the respirator includes a system for controlling the speed of the fan 26. The respirator 10 includes a bypass conduit 44 for abstracting a portion of the air flow from the air delivery duct 24. With reference to figures 4 and 6, air entering the bypass conduit 44 from the duct 24

flows into an air flow sensor 46, such as, for example, a Honeywell AWM series mass air flow sensor, and, from the sensor, back into the remainder of the air flow within the duct 24. Alternatively, the bypass conduit may exhaust directly into the breathing zone.

A mass air flow sensor typically comprises two temperature sensors, such as thermistors, within a conduit, one of each side (upstream and downstream) of a heater. The heat transfer characteristic of the heater is linked to the number of air molecules passing across it at a certain velocity. A signal output from the sensor is indicative of the mass flow rate within the bypass conduit 44, as determined from the temperature difference between the two temperature sensors. The signal 48 is received by a microprocessor 50, which determines from the signal the mass flow rate within the duct 24, the relationship between the flow in the duct 24 and the conduit 44 having being previously determined and programmed in the microprocessor. From the thus-measured flow rate in the duct 24, the microprocessor 50 controls the mark/space ratio of a signal output to the motor of the fan 26 in order to maintain a constant flow rate in the air duct 24. This enables any drop in the flow rate due, for example, to the gradual build-up of debris in the air filter 28 or loss of battery power, to be compensated for by increasing the fan speed.

Upon starting the system, there is a time delay, typically of a few minutes duration, before the heater reaches its operating temperature. In view of this, operation of the fan 28 is delayed by the microprocessor 50 until the heater has reached its operating temperature, power to the heater being initially boosted by the microprocessor 50 in order to minimise this delay. As the condition of the air filter is initially unknown, the control signal output to motor for the fan initially has a predetermined mark/space ratio. This ratio is then adjusted coarsely according to the output from the detector 46 so that the flow rate falls rapidly within a target window, and then more accurately so that the flow rate is at a target value. The microprocessor 50 will then continually make small adjustments to the mark/space ration to maintain a target flow rate through the duct 24. A boost switch may be

provided for use by the user to temporarily increase the air flow.

In order to alert the user 22 of a measured drop in the flow rate through the conduit, a display 52 connected to the microprocessor 50 is provided on the visor 14. For example, the display 52 may comprise a series of light emitting diodes, the diodes being illuminated progressively by the microprocessor 50 depending on the mark/space ratio of the signal supplied to the motor of the fan, the level of which is indicative of problems associated with, for example, the degree of blocking of the air filter.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

CLAIMS

1. A respirator comprising a hood for enclosing at least the face area of a user, a filter, a fan for generating a flow of air through the filter, a duct for delivering the flow of filtered air to the vicinity of the user's face, a bypass conduit for abstracting a portion of the flow from the duct and subsequently returning the abstracted portion to the remainder of the flow, means for measuring the flow rate of air through the bypass conduit and means for controlling the fan in response to the measured flow rate.

2. A respirator according to Claim 1, wherein said control means is arranged to control power supplied to a motor of the fan depending on the measured flow rate.

3. A respirator according to Claim 2, comprising display means mounted on said visor for generating a visual alert depending on the output to the motor.

4. A respirator according to any preceding claim, wherein the fan is a tangential fan arranged to receive the filtered air flow from the filter substantially parallel to the axis of rotation of the blades of the fan and to discharge the air flow tangentially to the arc described by the tips of the blades into the duct.

5. A respirator according to any preceding claim, wherein said measurement means comprises a mass air flow sensor.

6. A respirator according to Claim 5, wherein said sensor comprises means in the bypass conduit for heating the abstracted portion for measurement of the mass flow rate thereof, said control means being configured to supply power to the fan when the heating means has reached a predetermined temperature.

7. A respirator substantially as herein described with reference to the accompanying drawings.

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ABSTRACT

A respirator comprises a hood for enclosing at least the face area of a user, a filter 28, a fan 26 for generating a flow of air through the filter, a duct 22 for delivering the flow of filtered air to the vicinity of the user's face, a bypass conduit 44 for abstracting a portion of the flow from the duct 22 and subsequently returning the abstracted portion to the remainder of the flow, means 46 for measuring the flow rate of air through the bypass conduit and means 50 for controlling the fan in response to the measured flow rate.

(Figure 4)

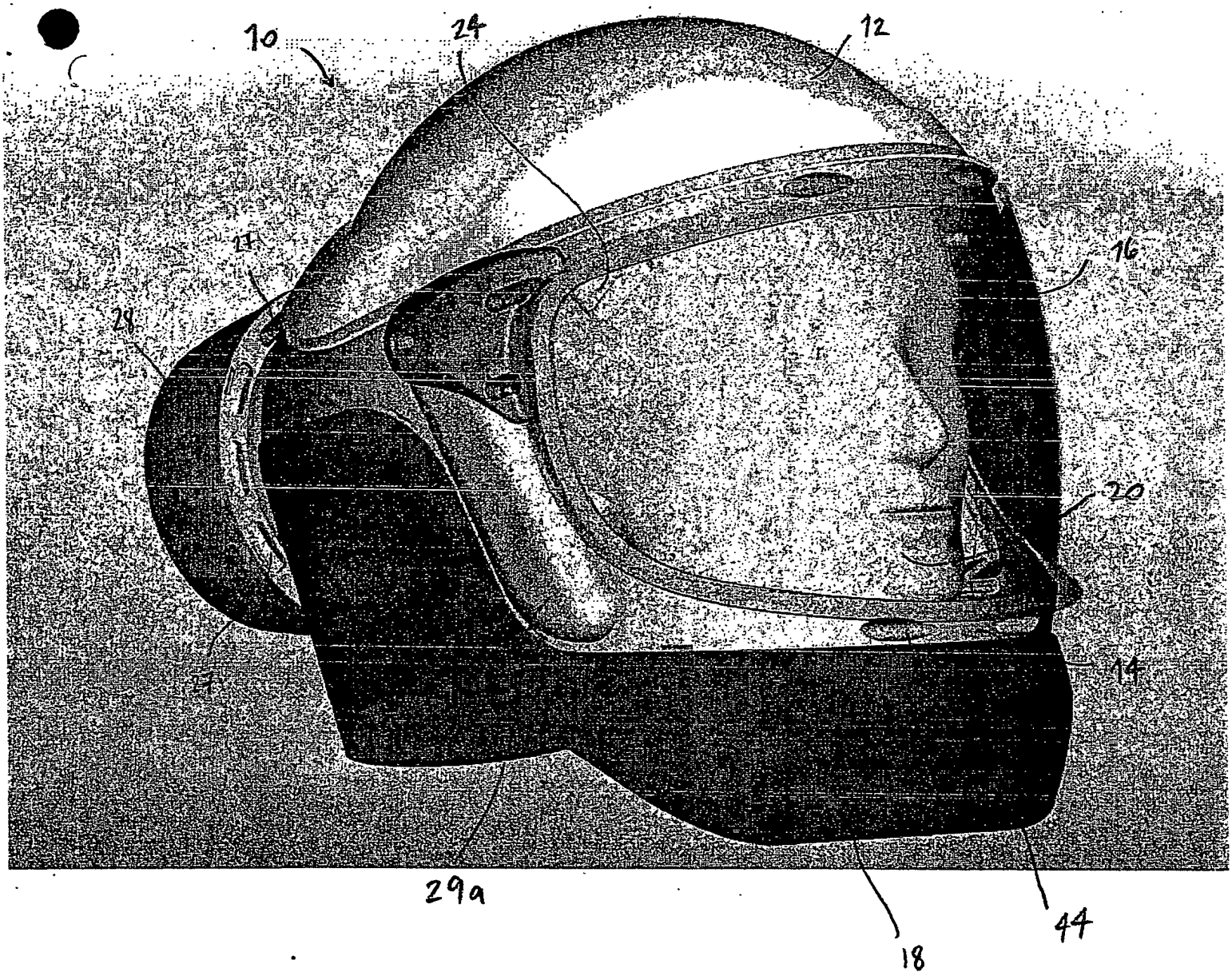

FIGURE 1

FIGURE 2

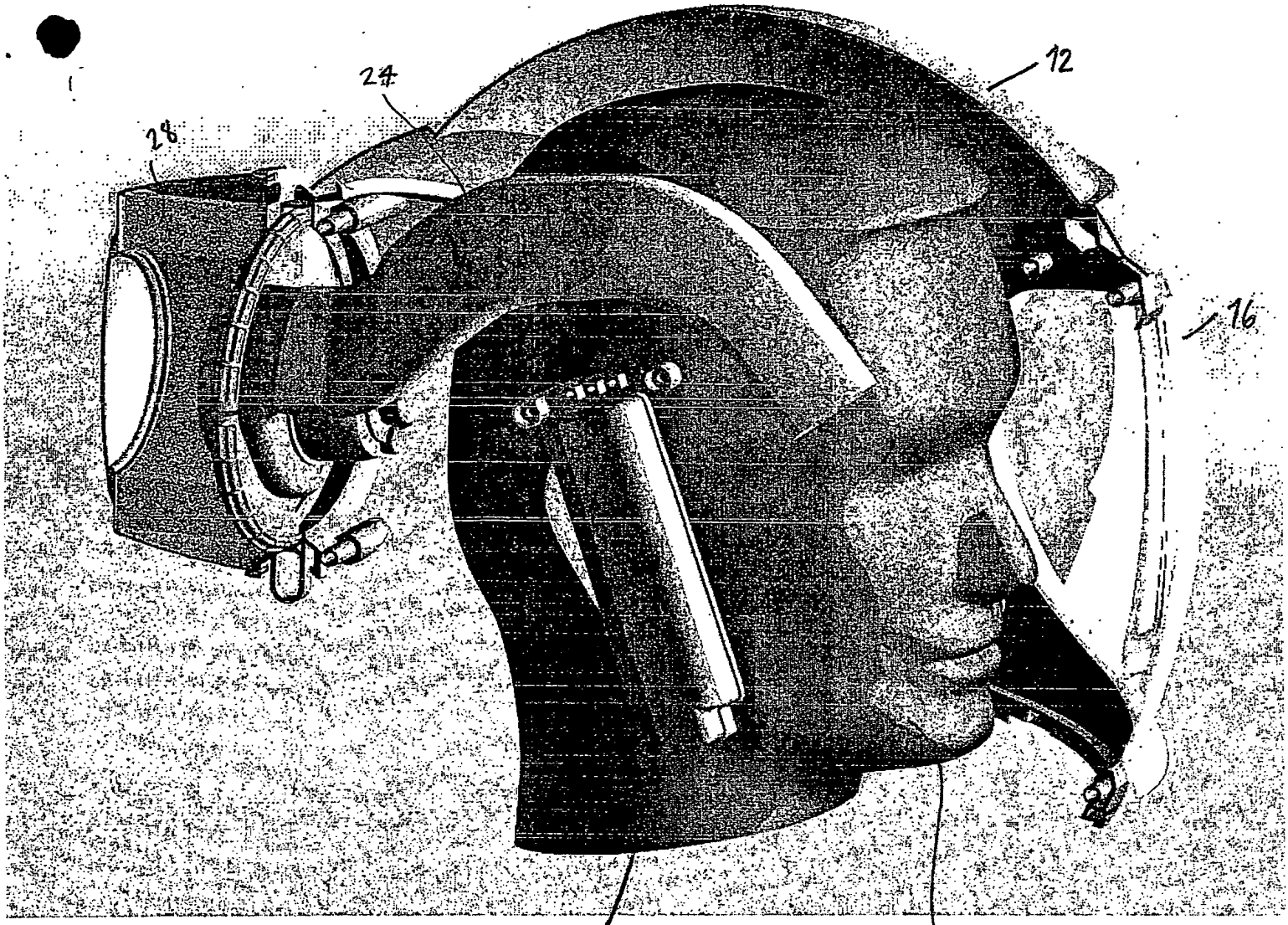

FIGURE 3

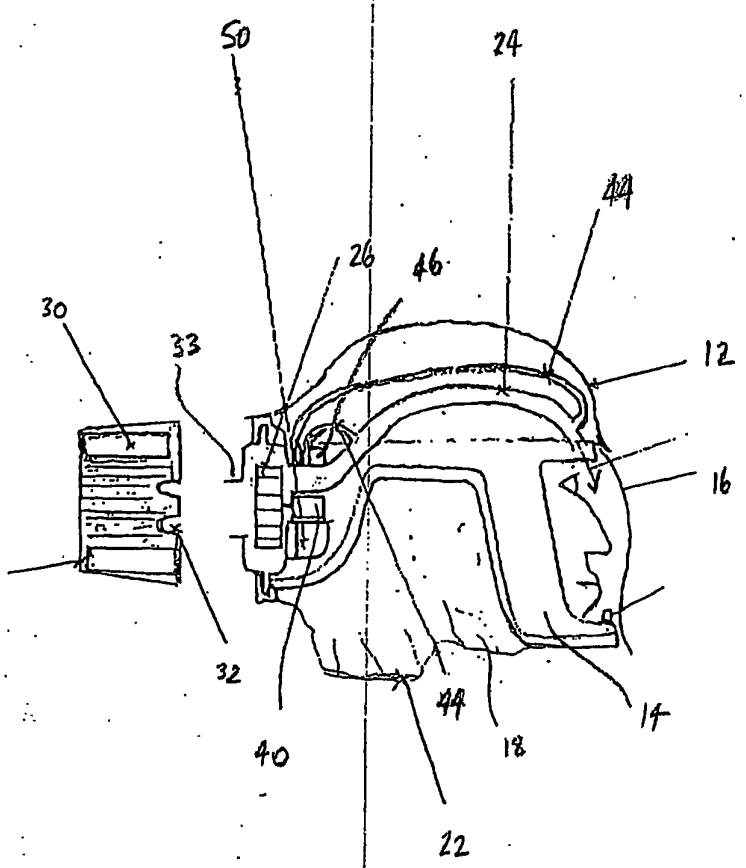

FIGURE 4

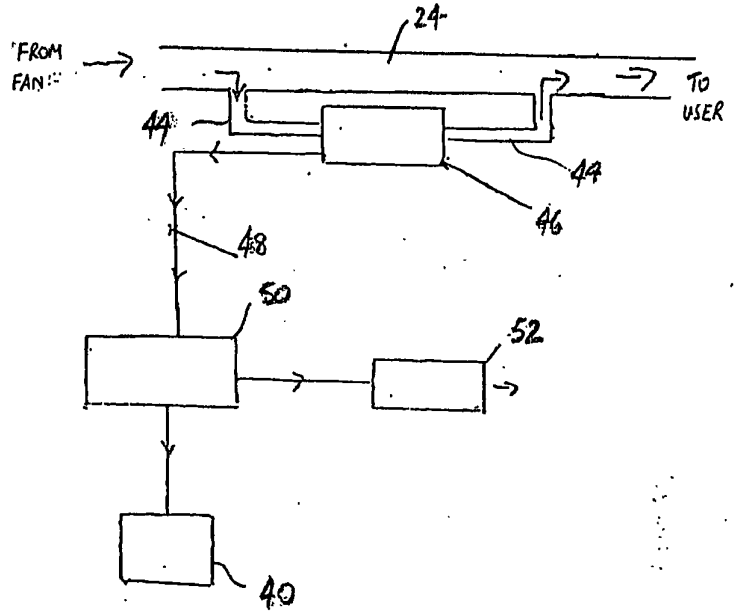

FIGURE 6

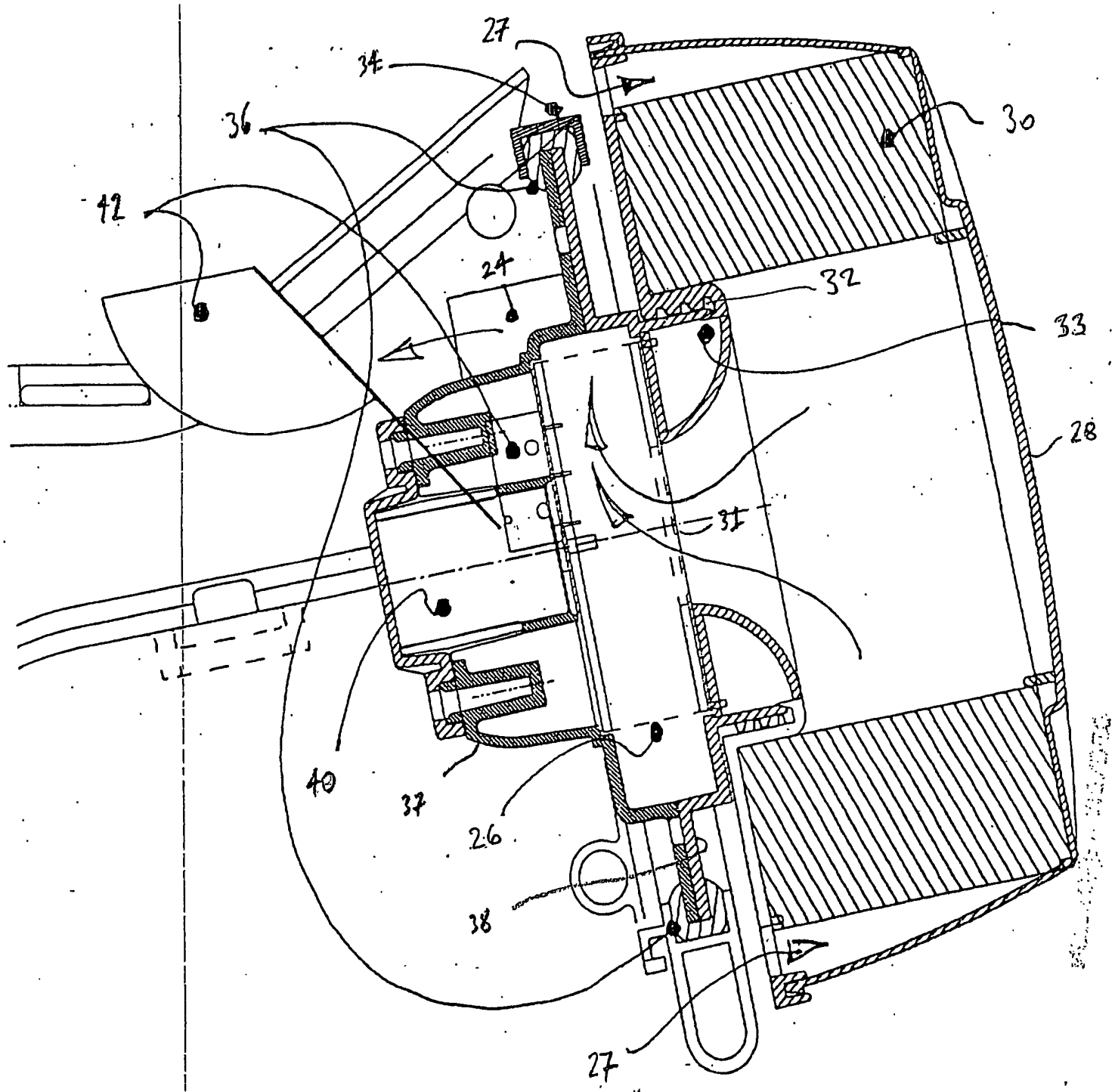

FIGURE 5